(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
11 July 2002 (11.07.2002)

PCT

(10) International Publication Number
WO 02/053796 A1

(51) International Patent Classification[7]: C23C 14/35, 14/04, H01L 21/768

(21) International Application Number: PCT/GB01/05795

(22) International Filing Date:
21 December 2001 (21.12.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0100151.0 4 January 2001 (04.01.2001) GB

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(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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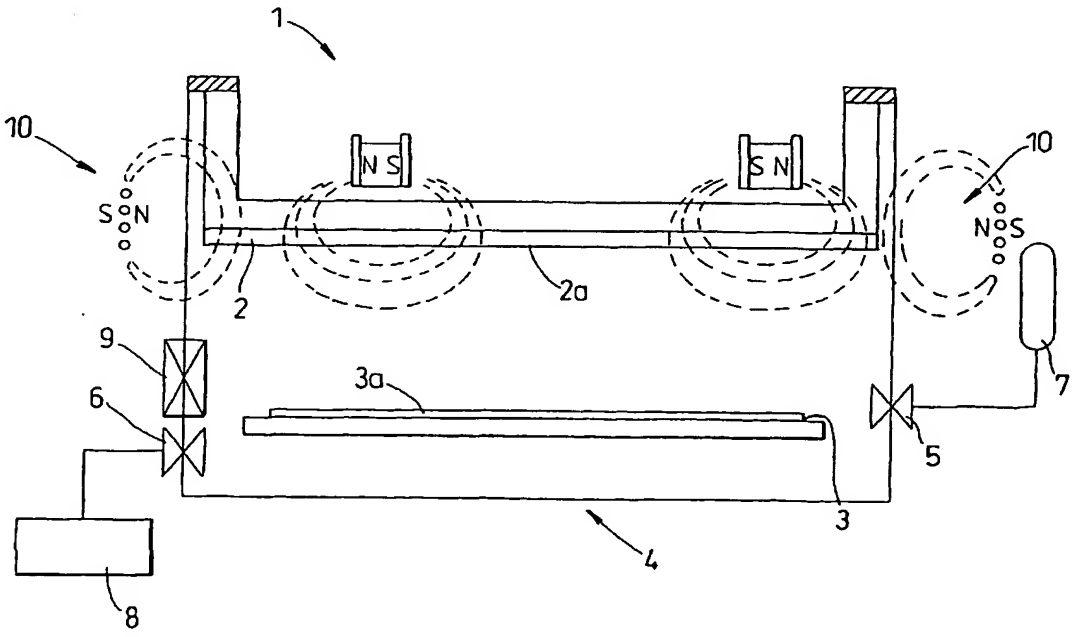
(54) Title: METHODS OF SPUTTERING USING KRYPTON



(57) Abstract: A method of sputtering a layer on a substrate having a plurality of recesses or openings includes using Krypton as a sputtering gas and is characterised in that the gas flow is less than 20 sccm and or the Krypton pressure is less than 1 militor.

WO 02/053796 A1

METHODS OF SPUTTERING USING KRYPTON

This invention relates to methods of sputtering a layer on a substrate having a plurality of submicron sized recesses or openings.

As the dimensions of features on semiconductor devices, and other substrates, get progressively smaller, it becomes progressively more difficult to get effective coverage at the base of holes or recesses in the substrates when depositing sputtered layers. Quite a usual representation of degree of success is to plot the ratio of the thickness of the layer B deposited at the base of such a hole or recess against the thickness F of layer deposited on the field or upper surface of the substrate. There are various techniques that can be used to improve this ratio. One is to bias the substrate. The second is to include a collimator or to separate the target and substrate sufficiently for most of the atoms reaching the substrate to be travelling in a direction normal to the surface of the substrate. This is sometimes known as a "long throw" configuration. However, it is generally the case that if, by collimation or the use of a long throw configuration, one had ensured that the vast majority of atoms are travelling normal to the surface of the substrate when they reach the substrate.

A third technique is to ionise the sputtered material either by an ionising coil, or by using high power levels to the sputter target. These techniques may be used

Although the invention has been defined above it is to be understood that it includes any inventive combination of the features set out above or in the following description.

The invention may be performed in various ways and a specific embodiment will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic view of an apparatus for performing a method of sputtering;

Figure 2 is a bar chart indicating the B/F ratio achieved for various sputtering conditions at the centre of the substrate; and

Figure 3 is the corresponding chart for features at the edge of the substrate.

In Figure 1, a target 2 and substrate support 3 are each contained within a vacuum low pressure vessel in the form of chamber 4 through which a gas can be streamed at low pressure via an inlet valve 5 and an outlet valve 6 from a respective gas source reservoir 7 and a vacuum pump 8. A substrate 3a can be placed on the substrate support 3 via a door 9. Plasma is confined by the coil assembly 10 thus enabling lower pressure operation at any given target voltage by lowering the plasma impedance. (A moving magnetron assembly 1 is associated with the target 2 that is powered by a power supply 11. The wafer may be biased by power supply 12. A detailed explanation of the operation of such a chamber is contained in our co-pending

edge, as shown in Figure 3, the base coverage produced by krypton, in a non bias set up, is an improvement on the argon case. At 0.24 millitorr pressure of Argon (the minimum that can be achieved with argon in the set up utilised) the B/F percentage had improved.

Switching to Krypton enables lower pressure operation ~ 0.15 millitorr was possible with the experimental target power supply. A considerably improved B/F percentage was achieved. This is not a predictable result. Theoretical calculations show that at 0.24 millitorr the mean free path of an Argon ion is 53cm - already comfortably exceeding the source to substrate distance of 43cm. No further improvement would therefore be expected from further reduced pressure operation. However at 0.15 millitorr, Krypton provides a significant improvement to the base coverage percentage. This lower pressure operation is most conveniently achieved by the use of Krypton as it enables lower voltage operation without special plasma ignition devices and/or high voltage power supplies that would be required for argon operation.

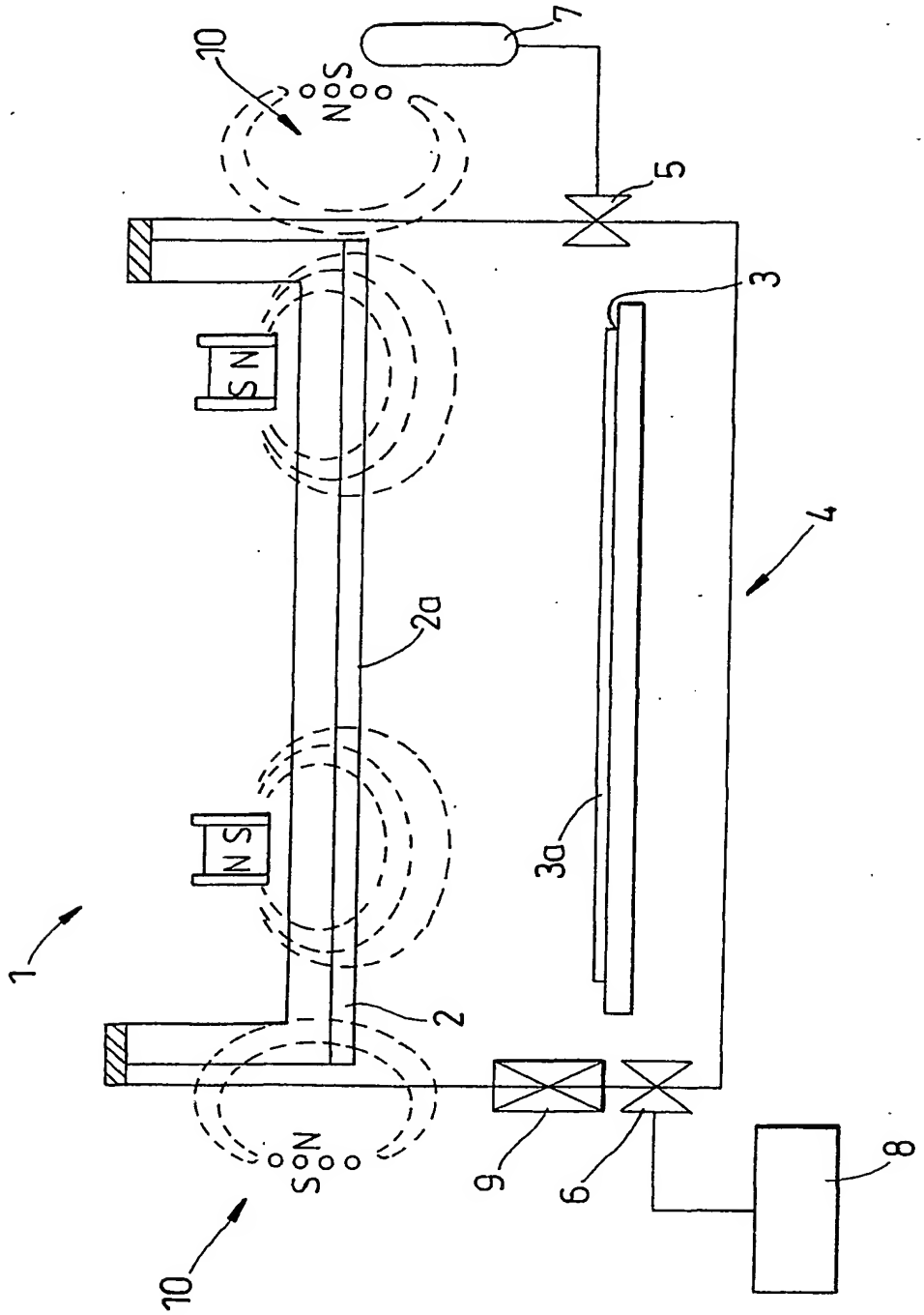


Fig. 1

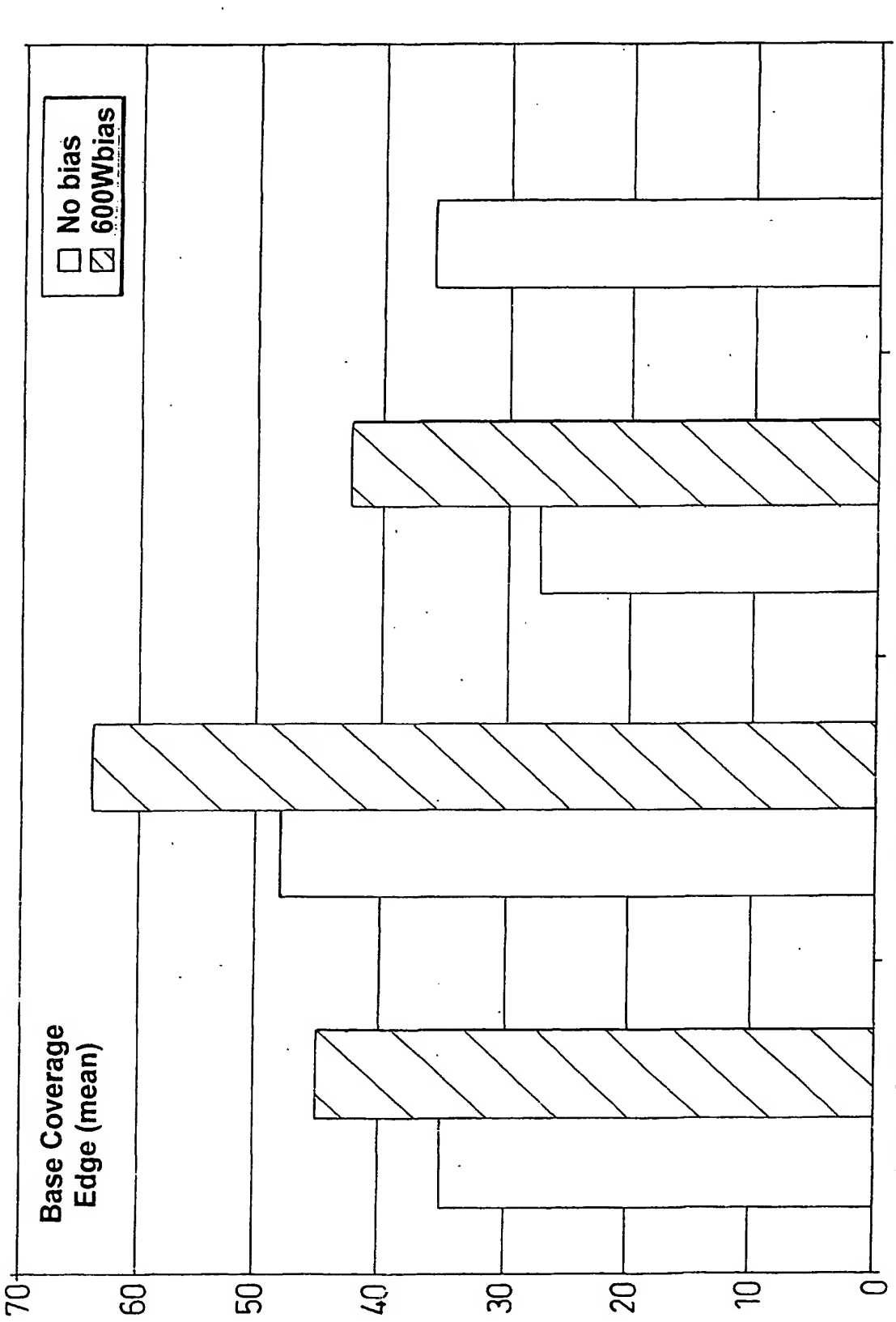

No bias
600Wbias
Base Coverage
Edge (mean)
70
60
50
40
30
20
10
0
Argon 0.24millitorr
Krypton 0.15millitorr
Argon 0.85millitorr
Krypton 0.85millitorr

Fig. 3

INTERNATIONAL SEARCH REPORT

International App
PCT/GB 01/05795

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